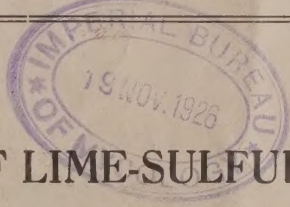




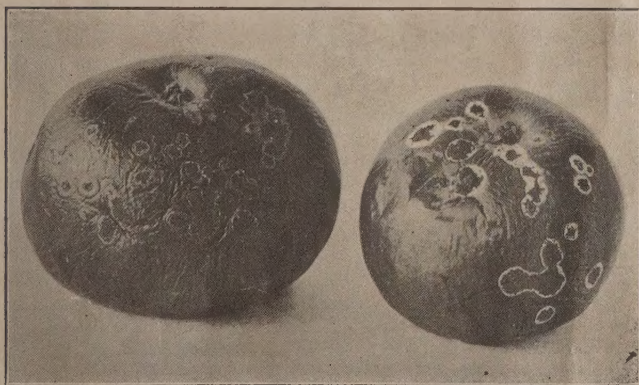
UNIVERSITY OF IDAHO
AGRICULTURAL EXPERIMENT STATION

DEPARTMENT OF HORTICULTURE



THE USE OF LIME-SULFUR as a SUMMER SPRAY FOR APPLE SCAB

By C. C. VINCENT



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INTRODUCTION

The object of this bulletin is to present to the fruit growers, having orchards in scab-infected areas of the state, such data as have been secured during the past three years on the use of lime-sulfur as a summer spray for apple scab. While scab is probably the most serious fungous disease with which the apple grower has to contend, results of spraying experiments show that it can be easily held in check. Three applications of lime-sulfur, if applied according to the recommendations made in this report, practically insure clean fruit.

HISTORY

Apple scab in Idaho was first brought to the attention of the Experiment Station (1) in 1897 by an orchardist near Juliaetta, Latah County. Concerning this infection, Henderson (1899) in his report made the following statement: "At present the scab has been seen on Fix and American Ridges to the west of the Potlatch, on the Little and Big Bear Ridges to the northwest of the Potlatch, and on the Potlatch Prairie to the east of the stream.

"A most peculiar feature of its prevalence is that while so common up and down the Potlatch, not a single orchard have I seen containing scab along the Clearwater, into which the Potlatch flows—a district about the city of Lewiston containing the oldest orchards in north Idaho. Not a case of its presence has come under my observation anywhere in the neighborhood of Moscow in the Palouse Country. This immunity I think due only to the comparatively young orchards of this district and to the slowness with which the disease seems to travel in this whole region."

From that time on, apple scab gradually made its appearance in other sections of the state (2). Henderson (1905) commenting further on this disease says, "The injury done to the apple by the scab and codling moth thruout the Palouse Country has become so serious that it is impossible to raise a salable crop without thoro spraying. In 1905 the scab and moth were both so bad as to discourage many apple growers, so that some did not spray at all, while a few began to pull out their trees, especially on American Ridge."

In 1913 a survey was made of the prevalence of apple scab in the state. The results of these investigations showed the disease to be prevalent in practically all of the apple growing districts of north Idaho. Orchards in at least ten counties showed scab infections.

In the fruit districts of south Idaho, apple scab is unknown at present. A brief description of the districts in which scab infections occur follows:

The North Idaho or Panhandle District (3)

This section includes the timbered territory of North Idaho. Most of the orchards are found in the vicinity of Coeur d'Alene, Hayden Lake, Pend Oreille Lake, Sandpoint, Bonners Ferry, Clarks Fork,

(1) Henderson, L. F.—Apple Scab in the Potlatch, Idaho Agr. Exp., Sta. Bulletin No. 20.

(2) Henderson, L. F.—Mixed Sprays for Apple Scab and Codling Moth, Idaho Agr. Exp. Sta. Bulletin No. 55.

Rathdrum and Post Falls. The annual precipitation is from 20 to 25 inches. The leading commercial varieties grown in this district are Wagener, Rome, King, Jonathan and Winter Banana.

The Palouse District

The commercial orchards are mostly located in the vicinity of Viola, Moscow, Potlatch, Genesee and Princeton. On the Camas Prairie, the larger plantings are found in the vicinity of Grangeville, Cottonwood and Nez Perce. The rainfall is 20 to 25 inches. The commercial varieties grown are Wagener, Grimes Golden, Rome and Jonathan.

The Lewiston District

This district includes the territory around the city of Lewiston in the Lewiston Valley and extends up the Clearwater Valley to Stites, and the Potlatch Creek Valley to Kendrick. The varieties that predominate in this district are Rome, Spitzenberg, Jonathan, Winesap, Yellow Newton and Delicious. The accompanying map shows the relative size of these districts.

ECONOMIC IMPORTANCE

The loss from scab in the state is far greater than is generally appreciated by the majority of the growers. From 10 to 75 per cent of the crop in unsprayed orchards is unfit for sale due to the presence of the scab fungus. Henderson (1899) observed the following conditions (4): "Although this disease has been in the Potlatch District but a few years, at one orchard on Pine Creek fully nine-tenths of the apples were scabby."

Under the provision of the State Horticultural Laws of Idaho, it is a violation of the law to place upon the market scab-infected fruit. Section 17 reads as follows:

"It shall be unlawful to sell, or offer for sale, or have in one's possession for sale or barter, any fruit which is or has been infected with San Jose Scale, *apple scab* or the larva or larvae of the codling moth or the peach-twig borer, and the fact that such fruit bears the marks of San Jose Scale, *apple scab*, or is worm-eaten by the larva or larvae of the codling moth or the peach-twig borer, shall be deemed conclusive evidence that such fruit is infected within the meaning of this section; and it is hereby made the duty of the State Inspector and the several deputy inspectors to prevent the sale of such infected fruit, and they are hereby given power to seize and destroy such infected fruit, whenever they shall find that the same has been packed, sold, shipped or offered for sale or is being held in any warehouse, store, salesroom or other place for the purpose of being sold, bartered, shipped or exposed for sale or barter. Provided, That nothing in this section shall be construed to prevent the utilization of such infected fruit in the manufacture of canned fruit, evaporated or dried products, fruit preserves, jellies, butters, cider or other fruit by-products within the state, as provided for in Section 16."

(3) Vincent, C. C. and Downing, G. J.—Recommended Varieties of Fruit for Idaho, Idaho Agr. Exp. Sta. Bulletin No. 83.

(4) Henderson, L. F.—Apple Scab in the Potlatch, Idaho Agr. Exp. Sta. Bulletin, No. 20.



Fig. I—Map of Idaho, showing scab-infected districts

The losses due to scab infections are equally as great in other states and counties. (5) Wallace (1913) discussing this subject says, "McAlpine (1902) estimated the average annual loss due to apple scab in Victoria, Australia, at approximately \$194,000, which is equivalent to \$48.50 per acre. Stevens and Sherman (1903) state that one grower reports an increase of \$1000 in value of his crop due to spraying, at an outlay of \$125 to \$150; and that in the state of Illinois, apple scab is estimated to have caused \$6,000,000 damage in one year, or sixty per cent of the total loss thru all enemies. Marlatt and Orton (1906) state that the loss from scab amounts to many million dollars each year."

The estimates given above are, in the majority of cases, based on the losses which occur in the reduction of the quantity of marketable apples. It may be pointed out that there are other losses of scarcely less importance, but perhaps more difficult to estimate with any degree of accuracy in dollars and cents. Morris (1914) sums them up as follows: (6)

(1) The premature dropping of young apples due to the attacks of the fungus on flowers, petioles and young fruits during or immediately following the blossoming period.

(2) The apples which mature are of smaller size.

(3) The loss due to the dropping of scabby apples before picking time.

(4) The keeping quality of the fruit is greatly impaired.

(5) The leaves are attacked and this results in impairing the vigor and health of the trees.

(6) The development of scab in storage.

PLAN OF WORK

The college orchard was selected to carry on the experimental work. The orchard was planted in 1905 and consisted of Jonathans, Romes, Grimes Golden and Wageners. It was divided into five plats and each plat received a different number of applications.

The primary purpose of the experiment was,

(1) To ascertain the value of lime-sulfur as a summer spray for scab.

(2) To determine the number of applications needed to hold the scab in check when applied according to the following schedule:

1. When the blossom buds show pink.

2. When the petals fall.

3. Three weeks after the petals fall.

4. Nine weeks after the petals fall.

Arsenate of lead was added at the rate of two pounds to 50 gal. of water, to the second and third applications.

DIRECTIONS FOR MAKING LIME-SULFUR

The lime-sulfur used for making these tests was made at the

(5) Wallace, E.—Scab Disease of Apples, Agr. Exp. Sta., Ithaca, N. Y., Bulletin No. 335.

(6) Morris, H. E.—A Contribution to Our Knowledge of Apple Scab, Montana Agr. College Exp. Sta. Bulletin No. 96.

University. In the local market, lime costs one cent per pound and the sulfur three and one-half cents per pound. The solution was made and diluted in accordance with the formula given below:

Table No. 1—Lime-Sulfur

Lump lime (pure).....	50 pounds
Sulfur	100 pounds
Water	50 gallons

Break the lime into small lumps and slake in the cooker with hot water. Make a smooth paste of the sulfur with water and add to slaking lime. Mix thoroly. Add water to make 50 gallons. Boil vigorously 45 minutes to one hour. Add water as needed to keep the volume up to 50 gallons. Stir continuously. When thru boiling, let settle, then draw off the clear liquid. The material may be kept for two or three days in an open barrel if covered with a thin layer of paraffine or oil to exclude the air. Dilute home-made or commercial lime-sulfur as follows:

Reading of hydrometer		Amount of dilution No. of gals. of water to 1 gal. of lime-sulfur solution	
Degrees Baume	Specific gravity	Winter spray 5 deg. Baume	Summer spray 1 deg. Baume
34	1.306	8¾	43¼
32	1.283	8	40
30	1.261	7¼	36¼
28	1.239	6½	32¾
26	1.218	5¾	29½
24	1.198	5	26
22	1.179	4½	22¾
20	1.100	3½	19¾
16	1.124	2¼	15

SPRAYING EXPERIMENTS

The results secured during the seasons of 1913, 1914 and 1915 are recorded in the following tables:

Table II Results of Spraying Wageners

Materials	Number of applica- tions	Time of application	Percent sound			Percent scabby			Total counted		
			1913	1914	1915	1913	1914	1915	1913	1914	1915
	Check		10	86	29	90	14	71	1868	712	1865
Lime-sulfur	One	When buds show pink	59	94	66	41	6	34	1787	1121	1821
Lime-sulfur and arsenate of lead	Two	1st: When buds show pink 2d: When petals fall	89	98	81	11	2	19	2286	3693	2284
Lime-sulfur and arsenate of lead	Three	1st: When buds show pink 2d: When petals fall 3d: Three weeks later	95	98	90	5	2	10	1255	5091	274

Table III Results of Spraying Grimes Golden

Materials	Number of applica-tions	Time of application	Percent sound			Percent scabby			Total counted		
			1913	1914	1915	1913	1914	1915	1913	1914	1915
	Check		66	98	65	34	2	35	3855	573	3828
Lime-sulfur	One	When buds show pink	97	98	93	3	2	7	3411	3099	9068
Lime-sulfur and arsenate of lead	Two	1st: When buds show pink 2d: When petals fall	99	99	93	1	1	7	5001	1525	13377
Lime-sulfur and arsenate of lead	Three	1st: When buds show pink 2d: When petals fall 3d: Three weeks later	99.5	99.5	97	.5	.5	3	4093	917	2011

Table IV Results of Spraying Rome Beauty

Materials	Number of applica-tions	Time of application	Percent sound			Percent scabby			Total counted		
			1913	1914	1915	1913	1914	1915	1913	1914	1915
	Check		19	93	44	81	7	56	223	712	339
Lime-sulfur	One	When buds show pink	24	95	56	76	5	44	135	774	1013
Lime-sulfur and arsenate of lead	Two	1st: When buds show pink 2d: When petals fall	59	98	59	41	2	41	1006	1994	779
Lime-sulfur and arsenate of lead	Three	1st: When buds show pink 2d: When petals fall 3d: Three weeks later	70	99	80	30	1	20	1617	2350	493

Table V Results of Spraying Jonathans

Materials	Number of applica-tions	Time of application	Percent sound			Percent scabby			Total counted		
			1913	1914	1915	1913	1914	1915	1913	1914	1915
	Check		17	97	30	83	3	70	111	1470	329
Lime-sulfur	One	When buds show pink	61	99	54	39	1	46	224	1747	659
Lime-sulfur and arsenate of lead	Two	1st: When buds show pink 2d: When petals fall	74	99.5	75	26	.5	25	354	2184	999
Lime-sulfur and arsenate of lead	Three	1st: When buds show pink 2d: When petals fall 3d: Three weeks later	91	99.8	88	9	.2	12	2732	6813	698

In 1913, the first application was made May 17th, the second, June 5th, the third June 27th, and the fourth August 5th. The season was wet and ideal conditions existed for scab development. Wallace (7) (1913) states, "The ideal condition for infection is a gentle continual rain followed by cloudy, calm weather and a saturated atmosphere in which case the spores are kept wet for a long time while in one position." The precipitation table shows that these conditions prevailed during the spraying season.

During the spring of 1914, the first application was made May 1st, the second May 25th, and the third June 14th. The difference between sprayed and unsprayed orchards this year was very small, due to unfavorable conditions for scab development. Notwithstanding this fact, fruit growers should not neglect to spray. Commercial orchardists, who have sprayed thru favorable and unfavorable seasons, for a period of years, have found that it is a good business proposition.

There was considerable rain during the season of 1915, especially from about the time the buds began to show pink until after the petals had fallen. Notwithstanding the unfavorable condition under which the experiments were conducted this year, the scab was fairly well controlled. The first application was made April 25th, the second May 29th, and the third June 19th. An important point in the control of this fungus is the time of making the various applications. Wallace (7) (1913) says, "Not only should the grower watch the conditions of the fruit buds, but he should also watch the weather and attempt to get the spray on ahead of general storm periods if possible. Many growers delay the spraying until after the rain is over if rainy weather happens to be threatening at that time, thinking that the rain will wash off the spray." Various experimenters have observed that if the spray has twenty or thirty minutes in which to dry before heavy rains occur, good results are secured.

As a result of our work for the past three years, we are convinced that lime-sulfur is an effective remedy for the control of apple scab. Good results were secured during the wet as well as the dry seasons.

Spraying reduced the scab on Wagener in 1913 from 90 percent in the check plat, to five percent with three applications; in 1914 from fourteen percent to two percent; and in 1915 from seventy-one percent to ten percent. On Grimes Golden in 1913, the scab was reduced from thirty-four percent to one-half percent; in 1914 from two percent to one-half percent; and in 1915 from thirty-five percent to three percent. The scab on Rome in 1913 was reduced from eighty-one percent to thirty percent; in 1914 from seven percent to one percent; and in 1915 from fifty-six percent to twenty percent. Spraying Jonathans in 1913, reduced the scab from eighty-three percent to nine percent; in 1914 from three percent to two-tenths percent; and in 1915 from seventy percent to twelve percent. See Tables II, III, IV, and V.

Four applications during the season of 1913 gave the following results: On Wagener, same results as when three applications were

made; Grimes Golden, no reduction over three applications; Rome reduced from thirty percent to twenty-one percent; and Jonathan from nine to eight percent. My observations, as well as the results recorded in 1913, caused me to discontinue the fourth application thruout the seasons of 1914 and 1915. Should rainy weather continue thruout the summer, a later application might be necessary for all varieties.

The data presented show some varieties to be less resistant to scab than others. On the check plats, the four varieties show an average percentage of scab during the past three years as follows: Grimes Golden, twenty-four percent; Rome, forty-eight percent; Jonathan, fifty-two percent; and Wagener, fifty-eight percent. As shown in the tables, neither one or two applications are sufficient to hold the scab completely in check. This is especially true of such varieties as the Wagener, Rome and Jonathan. The Grimes Golden is quite resistant to scab infections, hence one application made at the time the buds are showing pink should reduce the fungus to a neglible quantity. I am led to this conclusion by data secured during the three year period. One application in 1913 reduced the scab to three percent; in 1914 to two percent and 1915 to seven percent.

Another important point in connection with the work of the past three years is the fact that no definite dates can be given for making the various applications. There was a difference of twenty days, in the time of making the first application during the past three years. The only safe guide to follow is to watch the development of the fruit buds and the weather.

Spraying alone is not sufficient in all cases but should go hand in hand with pruning, cultivation, fertilization, etc., if perfect crops of apples which bring the highest market prices are to be raised.

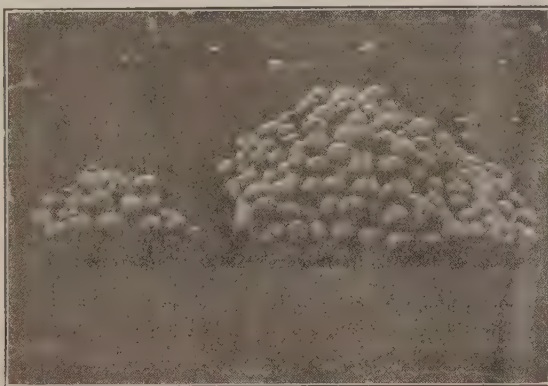
To assist the spraying operations, sanitary measures should be followed. The fallen leaves should be turned under in the fall or early spring. This lessens the danger from primary infection. Rotten fruit, dead branches, etc. should also be removed. Opening up the trees so as to insure a good circulation of air also aids in controlling the scab.

CLIMATIC CONDITIONS

The amount of precipitation in April, May, and June for the past three years is shown in the following table:

Table VI—Showing Date and Amount of Precipitation during the Spraying Seasons, in inches.

Date	Amount of precipitation			Date	Amount of precipitation			Date	Amount of precipitation		
	April	May	June		April	May	June		April	May	June
	1913	1913	1913		1914	1914	1914		1915	1915	1915
1	.05			1	.05			1	.09	.06	
2				2			.22	2	.27		
3				3		.40		3			
4	.08			4	.50		.12	4			
5	.20			5	.07			5			
6	.05			6	.02			6	.09		
7				7			.14	7			
8			.45	8		.35		8			
9		.03	.01	9			.03	9		.71	
10		.20		10		.18		10		.10	
11	.30			11	.10		.02	11	.20	.38	.37
12		.46		12	.25			12	.20		.01
13	.05	.20		13	.01		.03	13		.15	
14		.12	.12	14	.25			14	.02	.01	
15		.12		15		.31 trace		15	.50		
16	.35	.02		16				16			
17				17				17		.82	
18		.31	trace	18	.11			18		.60	
19	.05	.02	.42	19	.01			19		.05	
20		.35	.20	20				20			
21				21				21		.05	
22		.15		22	.25	.24		22	.10	.06	
23	.13	.46		23	.01			23		.02	
24		.28		24		.29	.50	24	.02	.15	
25		.30		25			.12	25		.10	
26				26	.02		.18	26		.06	
27		.30		27		.23		27		.52	
28		.23	.15	28				28			
29		.04		29				29	.53		
30				30				30	.05	.01	
31				31				31		.23	



10 percent clean

90 percent scabby

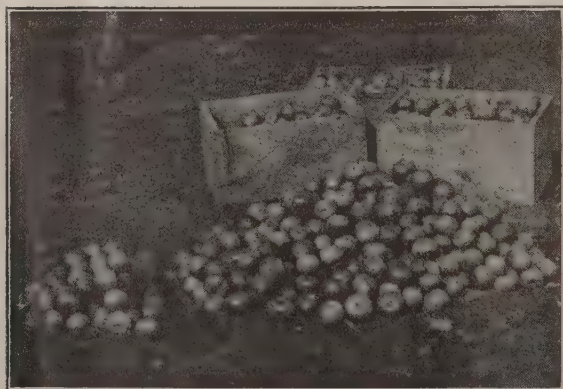
Fig. II—Apples from Wagener check plat



59 percent clean

41 percent scabby

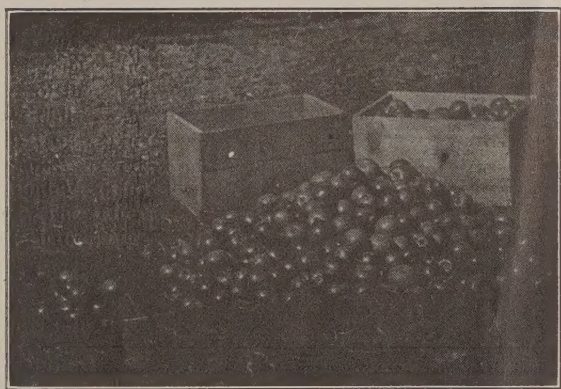
Fig. III—Results with one application—Wagener variety



11 percent scabby

89 percent clean

Fig. IV—Results with two applications—Wagener variety



5 per cent scabby 95 percent clean
Fig. V—Results with three applications—Wagener variety

The rainfall during the month of April, 1913, was rather light. There were eighteen cloudy and partly cloudy days. In May nineteen days were cloudy and partly cloudy. June had twenty-one cloudy and partly cloudy days. It is evident that the greatest scab development occurred during the months of May and June. The large percentage of scab in the orchard was due to secondary infections made possible by the damp weather later in the summer.

In April, 1914, the records showed only seven clear days. From results obtained at the close of the season, as shown in Tables II, III, IV, and V, it appears that cloudy weather in April has little to do with scab development. Presumably the spores are not fully mature at that time. In May there were twenty clear days. As but very few scab infections occurred later in the summer, it is evident that the clear weather in May was responsible for holding the scab down to a minimum.

From the above data, it can be readily preceived that the prevalence of scab in May, 1915, was due to the unusually rainy weather. There were only nine clear days during the month. As there were twenty-four clear days in June, very few scab infections occurred later in the summer.

APPARATUS USED

A good power spraying outfit was used in these experiments. It consisted of the following parts: (1) Novo Engine, $2\frac{1}{2}$ H. P., hopper cooled, with pulley and complete jump spark battery equipment.

(2) Giant three-cylinder power pump with gauge, pressure regulator and twelve-to-one double back gears.

(3) 200-gallon tank with removable strainer and cut off and an iron well connecting with underneath suction; tool box, foot board and driver's seat.

(4) Complete rotary agitator fitted in tank and connected with pump.

- (5) Special steel platform with all above parts connected up and securely fastened in position.
- (6) Hinged wood cover with canvas sides and end covering engine and pump; also fitted with hooks for carrying hose and rods.
- (7) Running gear with 4-inch depressed tires; 4 feet between centers; 4000 pounds capacity.
- (8) 100 feet of spray hose, fitted ready for use, in two lengths of 50 feet each.
- (2) Two ten-foot bamboo extensions with nozzles and two cut-offs.

With this outfit no difficulty was experienced in keeping up a good pressure. The Bordeaux nozzle was used. During the second and third application, arsenate of lead was added to the lime-sulfur in order to control the codling moth. To secure best results every portion of the tree should be covered with spray. The secret of success in controlling scab, is making the application at the proper time, securing proper distribution of the spray, applying with high pressure, and covering the buds, fruits, limbs and leaves thoroly.

SPRAYING COSTS

In spraying operations, the cost of applications are items that must be considered. The data presented in this report are conclusive evidence that it does pay to spray for it has doubled and trebled the yield of sound, marketable fruit. The cost of spraying will naturally depend upon conditions under which the applications are made; labor, source of supply, cost of material, etc. The cost of making the lime-sulfur and applying it will now be given.

To make 50 gal. Lime-sulfur. (See formula on Page 7.)

50 lbs. lime at 1c per lb.....	\$.50
100 lbs. sulfur at 3½c per lb.....	3.50
Labor40

Total Cost\$4.40

Cost per gal.....8.4 cents

In these calculations, the fuel used, and the lime-sulfur vat, are not taken into account for it was presumed that the growers already have these. A vat holding 50 gallons can very easily be made at a cost not to exceed five dollars.

COST OF SPRAYING AN ACRE

Number of trees per acre.....	50
To spray 50 trees required 150 gal. of diluted lime-sulfur.	
4½ gal. concentrated lime-sulfur.....	\$.396
Labor90
Gasolene067
Cost of spraying, one application.....	1.363
Cost of spraying, three applications.....	4.08
Cost per tree, one application.....	.027
Cost per tree, three applications.....	.081

That it has payed to spray the college orchard during the past

Table VI.
Net Returns per acre
Unsprayed

	WAGENER				GRIMES GOLDEN				ROME				JONATHAN			
	1913	1914	1915		1913	1914	1915		1913	1914	1915		1913	1914	1915	
Total yield in boxes....	150	200	130		340	125	585		95	180	80		107	250	83	
Returns on scabby fruit	\$13.50	\$2.80	\$9.23		\$11.56	\$2.25	\$20.48		\$7.70	\$1.26	\$4.48		\$8.88	\$.75	\$5.81	
Returns on clean fruit.	15.00	172.00	37.70		224.40	122.50	380.25		18.05	167.40	35.20		18.19	242.50	24.90	
Net returns	\$28.50	174.80	46.93		235.96	122.75	400.73		25.75	168.66	39.68		27.07	243.25	30.71	

One Application

	WAGENER				GRIMES GOLDEN				ROME				JONATHAN			
	1913	1914	1915		1913	1914	1915		1913	1914	1915		1913	1914	1915	
Total yield in boxes....	150	200	130		340	125	585		95	180	80		107	250	83	
Returns on scabby fruit	\$6.15	\$1.20	\$4.42		\$1.02	\$2.25	\$3.94		\$7.22	\$1.90	\$3.52		\$4.17	\$.25	\$3.82	
Returns on clean fruit.	88.50	188.00	85.80		329.80	122.50	555.65		22.80	171.00	44.80		65.27	247.50	44.82	
Cost of spraying.....	1.36	1.36	1.36		1.36	1.36	1.36		1.36	1.36	1.36		1.36	1.36	1.36	
Net returns	\$93.29	189.20	88.66		329.46	121.39	558.23		28.66	170.54	46.96		68.08	246.39	47.28	
Gain over no application	\$64.79	14.40	41.93		93.50	-1.36	157.50		2.91	1.88	7.28		41.01	3.14	16.57	

Two Applications

	WAGENER				GRIMES GOLDEN				ROME				JONATHAN			
	1913	1914	1915		1913	1914	1915		1913	1914	1915		1913	1914	1915	
Total yield in boxes....	150	200	130		340	125	585		95	180	80		107	250	83	
Returns on scabby fruit	\$1.60	\$-.40	\$2.47		\$-.34	\$1.13	\$3.94		\$3.90	\$1.36	\$3.28		\$2.78	\$.13	\$2.08	
Returns on clean fruit.	133.50	196.00	105.30		336.60	123.75	555.65		56.05	176.00	47.20		79.38	248.75	62.25	
Cost of spraying.....	2.72	2.72	2.72		2.72	2.72	2.72		2.72	2.72	2.72		2.72	2.72	2.72	
Net returns	132.38	193.68	105.05		334.22	121.16	556.87		57.23	174.04	47.76		78.24	246.16	61.61	
Gain over no application	103.88	18.88	58.12		98.26	-1.59	155.14		31.48	5.38	8.08		51.17	2.91	30.90	

Three Applications

	WAGENER				GRIMES GOLDEN				ROME				JONATHAN			
	1913	1914	1915		1913	1914	1915		1913	1914	1915		1913	1914	1915	
Total yield in boxes....	150	200	130		340	125	585		95	180	80		107	250	83	
Returns on scabby fruit	\$1.75	\$-.40	\$1.30		\$-.17	\$-.06	\$1.76		\$2.85	\$1.18	\$1.60		\$-.96	\$.05	\$1.00	
Returns on clean fruit.	142.50	196.00	117.00		338.30	124.37	567.45		66.50	178.20	64.00		97.37	249.50	73.04	
Cost of spraying.....	4.08	4.08	4.08		4.08	4.08	4.08		4.08	4.08	4.08		4.08	4.08	4.08	
Net returns	139.17	192.32	114.22		334.39	120.35	564.13		65.27	174.30	61.52		94.25	245.47	69.96	
Gain over no application	110.67	17.52	67.29		98.43	-2.40	163.40		40.52	5.64	21.84		70.18	2.22	39.25	

three years, is shown in the following table. A study of the data shows that in dollars and cents, the results have been most gratifying. The yield per acre is given in boxes and represents an average of the total yield in each plat. The sale of fruit is estimated at five dollars per ton for the scabby and one dollar per box for the clean fruit. The percentage of scabby and clean fruit is based on the results secured in the spraying plats as indicated in Tables II, III, IV, and V. The data presented represent what spraying alone can do. The other orchard operations, such as pruning, cultivation, thinning, harvesting, etc. have been considered in working out these data.

AVAILABLE PUBLICATIONS

The following Publications may be obtained, without cost, by addressing the Agricultural Experiment Station, Moscow, Idaho.

The list below may be obtained, also without cost, by addressing the Department of Agricultural Extension, Boise, Idaho.

Bulletins

60. Conditions affecting the Production of Denatured Alcohol in the Northwest.
65. Alaska Wheat Investigations.
72. A Report on the Milling Properties of Idaho Wheat.
73. A Study of Idaho Butter with Suggestions for Improvement.
75. Composition of Irrigated and Non-Irrigated Fruits.
76. Tomato Culture in Idaho.
77. Lamb Feeding and Sheep Husbandry in Idaho.
78. Irrigation Practice.
79. Potato Culture.
81. Soils of the Cut- and Burned-Over Areas of North Idaho.
82. Canning Fruits and Vegetables on the Farm.
84. The Annual Report of the Experiment Station for Year Ending June 30, 1915.
85. The Use of Lime-Sulphur as a Summer Spray for Apple Scab.
86. Some Poisonous Plants of Idaho.
87. Insect Pests of the Orchards and Gardens of Idaho, and Their Control.

Circulars

- No. 1. Spray Calendar.
- No. 2. Field Peas.

Bulletins

3. Measurement of Irrigation Waters.
5. Hog Cholera in Idaho.
6. Rural School Lunches.
7. The Alfalfa Weevil.
8. Directory of Idaho Pure-Bred Breeders.
9. The County Agriculturist Movement.
10. Batters and Doughs.
11. Third Year Sewing-Girls' Club Work.
12. Instructions for Canning Fruits and Vegetables.
13. First Year Sewing-Girls' Club Work.
14. First Year Cooking—"Bread."
15. General Club Announcement.
16. Meat.

Circulars

1. Weeding Out Poor Orchard Varieties.
9. Hints to Help Chicken Raisers.
10. Home Economics Schools.
11. Farmers' Schools
14. How to Keep Fowls Healthy.
15. Fitting Fowls for Exhibition.

Idaho Farm Hints

20. Help Fight Hog Cholera.
21. Warning. Look Out for Potato Diseases.